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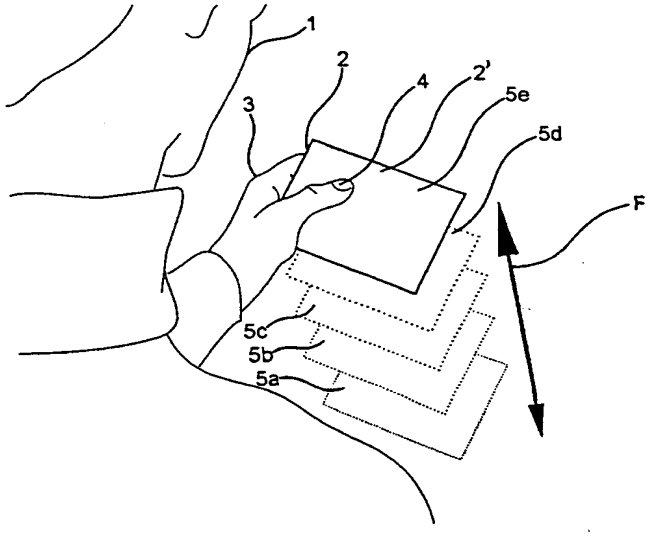
(54) Title: OPERATION METHOD OF USER INTERFACE OF HAND-HELD DEVICE



(57) Abstract: An operation method of a user interface of a handheld device, like a palm-size or pocket-size PC, mobile telephone, communicator or equivalent, in which method data on a display of the device is changed for finding or selecting desired data, is characterized in that data (5a - 5e) on the display (2') of the device is changed responsive to certain movements (F) of the device in a three-dimensional space of use thereof, and said movements of the device and the corresponding changes of the data on the display are defined so that a movement and a corresponding change of data on the display have a cause-consequence relationship which is analogous to cause-consequence relationships of the three-dimensional space of perception and action of a user (1).

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Operation method of user interface of hand-held device

The invention is related to an operation method of the user interface of a hand-held data-processing device. A hand-held device means here a palm-top or pocket computer, mobile phone, communicator or like device, essential features of which include displaying data on the display of the device and in which data on the display of the device is changed for finding and selecting a desired data.

User interfaces of above mentioned devices are presently mostly of type "point and click". A general operation method of a user interface is browsing and selecting data by means of keys. Palm-top computers are usually managed with a touch sensitive display, a virtual keyboard, a pen, and often some auxiliary hard keys or buttons. Firstly, this kind of user interfaces are difficult to use for small size of the devices and correspondingly the keys or virtual keys. On the other hand, the use becomes more difficult as the devices are continuously provided with new applications and services which are to be used with the same small quantity of small-sized keys. Characteristic of these user interfaces, like user interfaces of computers and other data-processing devices, is generally also that they have their own artificial logics and rules which are fully adopted and known only by a few, normally technically orientated users.

An object of the invention is to present such an operation method of the user interface of hand-held devices which to large extent removes many of the above mentioned problems.

To reach this object, the operation method of the user interface of a hand-held device, like palm-top or pocket computer, mobile phone, communicator or like, according to the invention, in which operation method data on the display of the device is changed for finding and selecting a desired data, is characterized in that what is defined by claim 1. Other claims define variable embodiments of the invention.

An advantage of the invention is that a user is able to easily adopt the operating rules of the user interface because they are "natural". The use of the device is also ergonomically easier because there is no need to use small-sized keys or auxiliary devices, for example.

The invention and some embodiments thereof are described in further detail in the following with reference to the accompanying drawings, in which:

Figs. 1 to 10 are schematic perspective views presenting examples of the operation method of the user interface of the invention;

Figs. 11 to 13 are schematic front views of a device and data presented on the display thereof and present some further examples of the operation method of the user interface of the invention;

Fig. 14 is a schematic presentation of an arrangement of data and operation of an application of the user interface of the invention;

Fig. 15 is a schematic perspective view of operation of a further application of the user interface of the invention; and

Fig. 16 is a flow chart presenting a possible realization of the operation method of the user interface according to the invention.

In Figs. 1 to 5, a user is holding a hand-held device 2 in his or her hand 3 and is using a device having a display 2'. The display 2' is a touch sensitive display, and the user is able to give a signal to the device by pressing the display with his or her thumb 4. Movements of the device 2 are detected by an acceleration measurement circuit installed in the device itself, for example, and the data obtained from the circuit is utilized in the operation of the user interface. Some possible ways of realizing the operation method of the user interface according to the invention are considered in further detail below. Figs. 1 to 5 present examples of the operation of the user interface.

With reference to Fig. 1, pages 5a, 5b, 5c, 5d and 5e, which may be e.g. weather maps obtained as a result of a web search, are browsed on the display 2' in response to moving the device 2 essentially perpendicularly to the display 2' thereof, as is indicated by arrow F. For the user, it is easy to think that he or she has a pile of pictures 5a to 5e ahead of him or her and that by moving in the pile he or she is able to see a picture at which he or she is at each time. In the same way, successive (or piled) pages of a book or other document may be thought to be browsed. The speed of browsing may be made dependent on quickness or intensity of the movement, i.e. on the magnitude of acceleration in the movement. The operation may also be arranged in such a way that a suitable small movement forward or backward and immediate stop bring the next page in the corresponding direction on the display. Furthermore, it may be arranged that a push of the touch sensitive display 2' gives a signal to the display control means in response to which signal changing of the data on the display is stopped. This kind of virtual use of depth increases significantly the capacity of a display having a restricted size.

With reference to Fig. 2, an image on the display 2' is zoomed larger, image 6b, or smaller, image 6a, in response to moving the device 2 in the same way as above, essentially perpendicularly to the display 2' thereof, as is indicated by arrow Z. This operation method of the user interface is fully analogous to human action as he or she wants to examine details of an object, e.g. an image, more closely. Having found a desired magnification, changing of the data on the display may be stopped again by a push of the display 2', for example. The functions of Figs. 1 and 2 may be used alternatively in a user interface according to application, whereby there is no indistinction of what is happening in response to moving

the device in this way. The function of Figs. 1 and 2 may also be combined in the operation of a user interface so that, for example, data is first browsed and then zoomed by means of the same movement. Then, it is advantageous to arrange a suitable selector for selecting one or the other of the functions. A selector of zooming may be a push of a certain area on the display, for example, whereby changing over from the zooming mode to the browsing mode may happen automatically by selection of a desired magnification ratio.

In Fig. 3, reference sign 7a indicates image data which is significantly larger than the display. The capacity of the display of a hand-held device is not large enough for large entities of factual or image data. In response to lateral movement of the device in essentially the plane of the display 2', as is indicated by arrows N, E, S and W, data 7b on the display is changed as if a window were moved above a larger image formed by the image data 7a. Having found a desired place, changing of data 7b on the display may again be stopped by a push of the display. It is logical to accomplish the functions of Figs. 2 and 3 together whereby the image data may be examined more thoroughly after zooming by selecting the data in the way described by Fig. 3. Moreover, e.g. number selection may be realized in this way without keys by moving the device above a large virtual keyboard and selecting the desired numbers one by one. This function makes it possible to read full-length web pages with a palm-top computer, for example.

With reference to Fig. 4, in response to a quick rotational movement of the device 2 as if around an axis formed essentially by the edge 9 thereof, i.e. in response to swinging the device like turning page of a book, as is indicated by arrow P, data 8a, 8b, 8c on the display 2' is changed correspondingly, e.g. a page of an electronic book is turned. By the direction of the swing, the direction of turning page is selected. The function may be arranged so that a small swing with quick stopping turns one page in the direction of the swing, and that in response to a more intensive swing, pages are browsed more quickly until the browsing is stopped by a push of the display.

In Fig. 5, an application is illustrated in which any part 9b of image data 9a forming a panorama picture covering the whole sphere of perceptual space (or respectively of image data forming a cylindrical picture) may be examined at a time. In the operation method of a user interface according to the invention, in response to moving the device 2 as if moving a picture on a corresponding spherical surface or in response to changing orientation of the device, that part 9b of the image data 9a which corresponds to the orientation of the display is obtained on the display 2'. At the same time, stopping and zooming of the image may be applied in the way described above. It may be contemplated also that a panorama picture is rotated by giving a push with a movement of the device to a desired direction, whereby the

panorama picture is correspondingly kept moving until moving is stopped by a push of the display, for example.

Figs. 6 to 10 present embodiments of the user interface of the invention in which data on the display is changed by tilting the device. In Fig. 6, an example is presented in which data, illustrated by data D1, on the display 2' of the device 2 is scrolled in the way indicated by arrow R1 to the direction to which the device is tilted in the way indicated by arrow T1. The initial position of the device is indicated by broken line and the tilted position by solid line. In other words, in response to tilting the device, the data on the display is rolling or running to the direction to which the device is tilted, which is fully analogous to cause-consequence realtionships of the real world. This may be realized in such a way, for example, that the changing velocity is the grater the more the device is being tilted or is tilted from the initial position. Rolling or running of the data may be stopped by returning the device to the initial position or by means of a key on the device, for example.

Fig. 7 presents an embodiment suitable for moving and searching objects on a map, for example. On the display 2,' a cursor C is placed which keeps its place thereon, and tilting the device in the way indicated by arrow T2 causes that data, illustrated by data D2, starts moving from the tilting direction towards to the cursor C in the way indicated by arrow M2. In other words, the cursor is moving on the data forming a map, for example, to the direction to which the device is tilted.

In the example of Fig. 8, data on the display 2' of the device 2 is illustrated by data D3. As the user is tilting the device 2 from the position indicated by broken line away from himself or herself, like going closer to the data on the display, the data on the display is enlarged, which is illustrated by a graph indicating enlarging of data D3 and arrow Z2. In the example of Fig. 9, data D4 on the display is correspondingly reduced, as is indicated by a graph illustrating the reduction and drawing away and by arrow Z3, by tilting the device towards the user in the way indicated by arrow T4.

The embodiments of Figs. 6, 7, 8 and 9 may be combined in the user interface of a device in such a way, for example, that there is a key on the device for selecting the operation mode (scrolling or zooming) whereby, first, an object is searched by tilting in the scrolling mode, for example, and having found the object, changing over to the zooming mode is made whereby tilting results in zooming the data on the display. Scrolling by tilting may, of course, be combined with zooming in the way described with reference to Fig. 2.

Fig. 10 presents schematically an embodiment of the user interface of the invention for selecting data objects on the display. Data objects D5 to D10 may be alternatives in a menu or selection buttons on a page, for example. In the initial position of the device 2 indicated by broken line, data object D5 selected which is indicated by hatching in the figure. Tilting

the device in the way indicated by arrow T5, the selection is moved to the direction of tilting, as is indicated by arrow M3, and is here moved to data object D9. Having selected the desired data object, it may be locked by a key on the device or by a return movement of the device, for example. For the sake of simplicity, tilting the device to only one direction and selection from data objects located one below the other are presented here, but in the same way it is, of course, possible to move between selectable objects also laterally.

Fig. 11 presents a further example of the embodiment described with reference to Fig. 3. Wide data D11 consists of objects which are described by letters arranged to form a matrix. By moving the device in the way indicated by arrows N, E, S and W one is as if moving above the data and looking at it through a window formed by the display 2'. As the desired data, here letter q, is found, it may be selected by means of a key on the device, for example. A comparable function may be realized also so that, instead of moving the device laterally, it is tilted to a direction to which one desires to move on the data.

Fig. 12 presents a further embodiment of the user interface of the invention for selecting an object on the display. On the display 2' of the device 2 there are objects O1 to O9 from which the selection is made. In the initial state at left, the cursor is close to the upper right corner of the display. In this embodiment, cursor C is as if anchored in place in the real world. As one desires to select object O7, the device 2 is moved laterally as if moving a picture under the cursor so that the desired object O7 is coming under the cursor C at right in the figure. There are keys 21, 22 and 23 on the device the operation of which may correspond to the operation of the buttons of a mouse. In fact, the embodiments of Figs. 10 to 12 are solutions which in hand-held devices replace solutions, like a mouse, in conventional computers which are needed for moving, moving a cursor or making selections on the display.

Fig. 13 presents an embodiment in which data objects, pages, cards or like, C1, ... , Ci, ... , Cn are arranged in a stack or one above the other on the display 2' of the device, like e.g. pages of a book in the real world. The data objects may be cards presenting articles of commerce or web pages, for example. The objects are browsed in the way indicated by arrow M4 forward and backword by tilting the device correspondingly either forward in the way indicated by arrow T6 or backward in the way indicated by arrow T7. By means of keys 24 to 26, objects may be selected and files, programs, etc. behind them be opened. There may be several modes in the user interface of a device, like browsing, scrolling, selecting and zooming described above, and e.g. key 24 may be for selection of mode and other keys 25, 26 and 27 may operate like the buttons of a conventional mouse.

Fig. 14 presents an application of the user interface of the invention in which data objects are arranged in radial stacks S11 to S18 to extend outwards from the circle of the

centre in which a device 2 and a user are. The first page of each stack, e.g. P12 or P16, defines data therebehind. Front pages may be browsed by turning the device laterally in the way indicated by arrow T8, for example, so that direction A12 and front page P12 are selected. The stack of data objects behind it may be browsed either by moving or tilting the device 2 forward and backward in the way indicated by arrow F1. In this way, e.g. a user interface for electronic shopping may be arranged and make perceiving the places of the products and orientation in a virtual shop easier.

Fig. 15 presents a further developed application of the embodiment described with reference to Fig. 5. Circles R1 and R2 present now image data forming a panorama picture or a 3D picture, in general, covering the whole sphere of the perception space. The image data may be also image data obtained from a video camera connected to the device. Three-dimensional image data D12 describing a thing, for example, may be brought to this image data and set in a desired place and desired position in "the real surroundings". In response to moving the device 2 in the way described with reference to Fig. 5, e.g. as indicated by arrow T9, both the background data and 3D data D12', D12'' describing the thing are changed in accordance with the positions of the device to correspond to viewing directions A1 and A2, so that the thing may be examined from different directions in "the real surroundings" thereof. This may be applied e.g. by searching the 3D model of a sofa from a web shop and by placing it in a desired place in an image data presenting one's house whereby it may be examined from different directions to see how the sofa looks like in the real surroundings thereof.

A solution according to the invention may be realized by providing a hand-held device by a multi-axial accelerometer, for example, and with suitable circuits and programs co-operating with the operating system of the device and possibly application programs for processing and interpreting measurement results so that a change of data on the display corresponding to a movement detected by the accelerometer is carried out. E.g. the realization with measurement of accelerations is based on application of as such known technical solutions, and a person skilled in the art, having provided with instructions and specifications, is able to realize the operation of the user interface according to the invention with reasonable efforts.

In small-sized data-processing devices, like palm-top computers, with prior art hardware technology, it is not possible to realize operation systems and applications with a capacity and usability which were even close to the level reached by larger data-processing devices, like desktop or laptop computers. It is also impossible to include conventional storage means, like hard disk, floppy disk or CD-ROM drivers, in hand-held devices. A solution of these problems may be a two-part data-processing device wherein in a hand-held

part there is only a part of necessary circuits and programs in addition to a display. The most of the circuits and programs are in another portable part held by the user, a wireless link connecting this part to the hand-held part. The wireless link may operate with IR or radio frequencies. In this kind of device, it is easy to realize at the same time a system which detects movement or position of the hand-held part in relation to the portable part. The operation method of the user interface according to the invention may then be realized by means of this system.

In the following, a further embodiment of the invention based on detecting accelerations is considered with reference to Fig. 16. The device includes a multi-axial accelerometer and necessary circuits and programs for measurements. The device being switched on, it is monitoring accelerations and in phase 11 is interpreting that an acceleration above a certain threshold is possibly an initial stage of a movement defined in the operation method of the user interface. In response to this, timers TD1 and TD2 are started in phase 12. TD1 sets a very short experimentally determined time of the order of milliseconds from the detected start of the movement, in which the actual direction and magnitude of the acceleration specify the movement which the user gives to the device. TD2 sets a longer time expiring of which stops changing data on the display if no other causes for stopping appeared. At the time of expiration of time TD1, the prevailing acceleration vector is measured in phase 13. In phase 14, it is examined if a detected vector is a defined vector, i.e. if it is corresponding to any movement defined in the operation method of the user interface. If not, the operation returns back to the beginning 10 and phase 11 to monitor accelerations of the device. On the other hand, if a vector is a defined vector, data on the display is changed in phase 15, e.g. is browsed, zoomed, etc., according to a corresponding algorithm. As is described above, e.g. determination of the browsing speed of data on the display on the basis of the magnitude of an acceleration vector may be related to this. In phase 16, it is also monitored at the same time if time TD2 is expired. If so, the operation is forwarded to phase 19 in which changing of data on the display is stopped and the procedure is finished in phase 20. If time TD2 is not expired, it is monitored if any opposite vector to the detected defined vector or any other stopping signal, like a push of the display, appear in phase 17. If an opposite vector or a stopping signal are detected in phase 18, changing data on the display is stopped in phase 19 and the procedure is finished. If no opposite vector or other stopping signals are detected in phase 18, the operation returns back to monitor above mentioned issues.

The operation method of the user interface of the invention may be realized also in other ways than by utilizing acceleration measurements. Any technique by which changes of place and position of the device may be measured may be applied. A solution which may be

contemplated is technique in which a place and orientation of the device are detected by sending pulsed DC magnetic field and by measuring it with a detector in the device. With this technique, both a place and position of the device in three-dimensional space may be fully detected.

A possible solution is also the technique on which so called optical mouse is based and in which a movement and speed thereof are detected by observing and analyzing any surface in the vicinity, which in this case could be a surface on the user, for example. By combining this with distance measurement, which is easy to realize, and by analyzing changes of distance and relative movement, changes of place, movement and position of a device may be detected.

The invention may, of course, be realized in various ways. It may be contemplated, for example, that for making detection of a defined movement more reliable, an acceleration is measured many times within a short time window, and a defined movement is detected if any one of the measured vectors meets the requirements for detection. Naturally, also a more complicated analysis of a movement based on successive measured acceleration vectors may be contemplaed. A movement of a device may be detected also with an arrangement, for example, in which distances are measured between transmitters and receivers placed in the device, on one hand, and on the user, on the other hand.

A user interface according to the invention may be realized according to use and necessary features of a hand-held device as a suitable combination of the embodiments presented above, the user interface including several operation modes in which the same movement of the device may correspond to different changes of data on the display. As is stated above in relation to some embodiments, there may be a key, for example, on the device for selecting different operation modes.

The invention may be varied within the scope of the accompanying claims.

Claims

1. An operation method of the user interface of a hand-held device, like palm-top or pocket computer, mobile phone, communicator or like, in which operation method data on the display (2') of the device (2) is changed in response to defined movements of the device in the three-dimensional space of use thereof and said movements of the device and the corresponding changes of data on the display are defined so that a movement and a corresponding change of data on the display have a cause-consequence relationship which is analogous to cause-consequence relationships of the three-dimensional space of perception and action of a user (1), characterized in that the operation method includes an operation mode in which in response to tilting (T6, T7) the device (2) data (S1, C1, ..., Ci, ..., Cn) on the display (2') is browsed (M4) to a direction corresponding to the direction of tilting.

2. An operation method of the user interface of a hand-held device according to claim 1, characterized in that one or more of the following features are further included in the operation mode:

in response to turning (T8) the device a stack of data (S12) from data arranged virtually in stacks (S11 - S18) on a circle surrounding a user of the device (2) is selected whereby the stack (S12) is browsed by tilting (F1) the device into the direction of the stack (S12) and away from it, respectively;

in response to moving (Z) the device (2) forward or backward perpendicularly to the display (2') data (6a) on the display is zoomed larger or smaller, respectively;

in response to moving (N, E, S, W) the device (2) essentially in the direction of the plane of the display (2') thereof data (q) from data (D11) larger than the display is selected; and

in response to having a cursor (C) placed on the display (2') and moving (N, E, S, W) the device (2) essentially in the direction of the plane of the display (2') thereof the cursor (C) is moved against the movement for selecting data (O1 - O9) on the display as if by moving data on the display in the real world below the cursor keeping its place in the real world.

3. An operation method of the user interface of a hand-held device according to claim 1, characterized in that the operation method further includes an operation mode in which in response to swinging (P) the device (2) like turning page also data (8a, 8b, 8c) on the display (2') is changed in the way corresponding to turning page.

4. An operation method of the user interface of a hand-held device according to claim 1, characterized in that the operation method further includes an operation mode in which in response to tilting (T2) the device (2) data (D2) is moved on the display (2') from the direction of tilting towards a cursor (C).

5. An operation method of the user interface of a hand-held device according to claim 1, characterized in that the operation method further includes an operation mode in which in response to tilting (T4) the device (2) selection of data (D5) on the display (2') is moved (M3, D9) into the direction of tilting.

6. An operation method of the user interface of a hand-held device according to claim 1, characterized in that the operation method further includes an operation mode in which in response to tilting (T3) the device (2) away from a user data (D3) on the display (2') is enlarged (Z2) and / or in response to tilting (T4) the device (2) towards a user data (D4) (2') is reduced (Z3).

7. An operation method of the user interface of a hand-held device according to claim 1, characterized in that the operation method further includes an operation mode in which displayed data is a desired part of a panorama picture (9a) and in response to turning the device (2) displayed data (9b) is changed so that the change of the viewing direction and the displayed part of the panorama picture (9a) correspond to turning.

8. An operation method of the user interface of a hand-held device according to claim 1, characterized in that the operation method further includes an operation mode in which displayed data is a desired part of a panorama picture or 3D image data (R1, R2) 3D and data (D12) describing a thing is placed in the image data and in response to turning the device (2) both the panorama picture data or 3D image data (R1, R2) and 3D image data (D12', D12'') are changed on the display (2') to correspond to the viewing direction (A1, A2) corresponding to the orientation of the device (2).

9. An operation method of the user interface of a hand-held device according to claim 1, characterized in that in response to stopping or significant slowing (18) of a movement changing of data on the display is stopped.

10. An operation method of the user interface of a hand-held device according to claim 1, characterized in that changing of data on the display is stopped by giving a signal to the device in other way than by means of movement of the device.

(57) Abstract

An operation method of a user interface of a handheld device, like a palm-size or pocket-size PC, mobile telephone, communicator or equivalent, in which method data on a display of the device is changed for finding or selecting desired data, is characterized in that data (5a – 5e) on the display (2') of the device is changed responsive to certain movements (F) of the device in a three-dimensional space of use thereof; and said movements of the device and the corresponding changes of the data on the display are defined so that a movement and a corresponding change of data on the display have a cause-consequence relationship which is analogous to cause-consequence relationships of the three-dimensional space of perception and action of a user (1).

(Fig. 1)

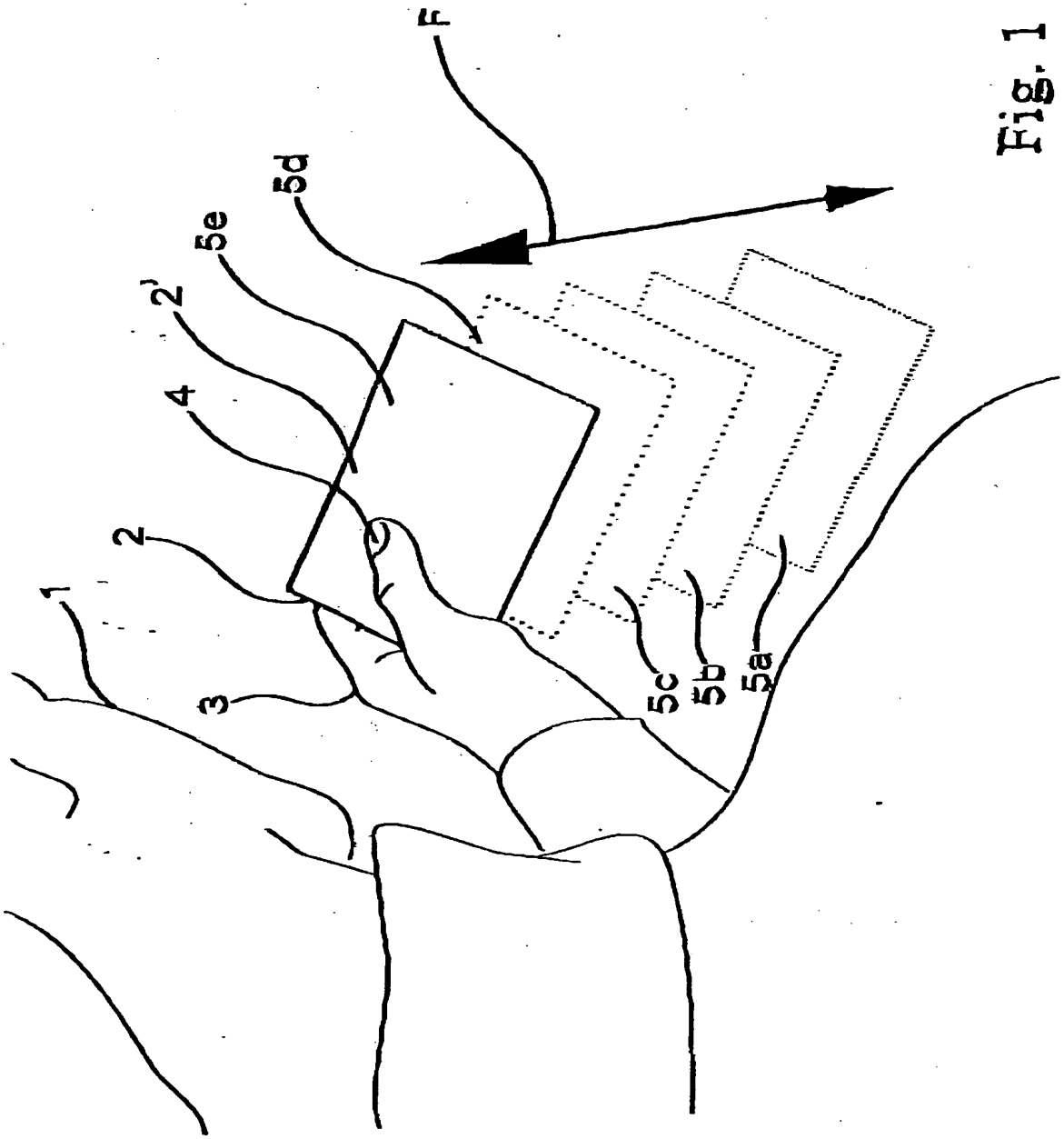

Fig. 1

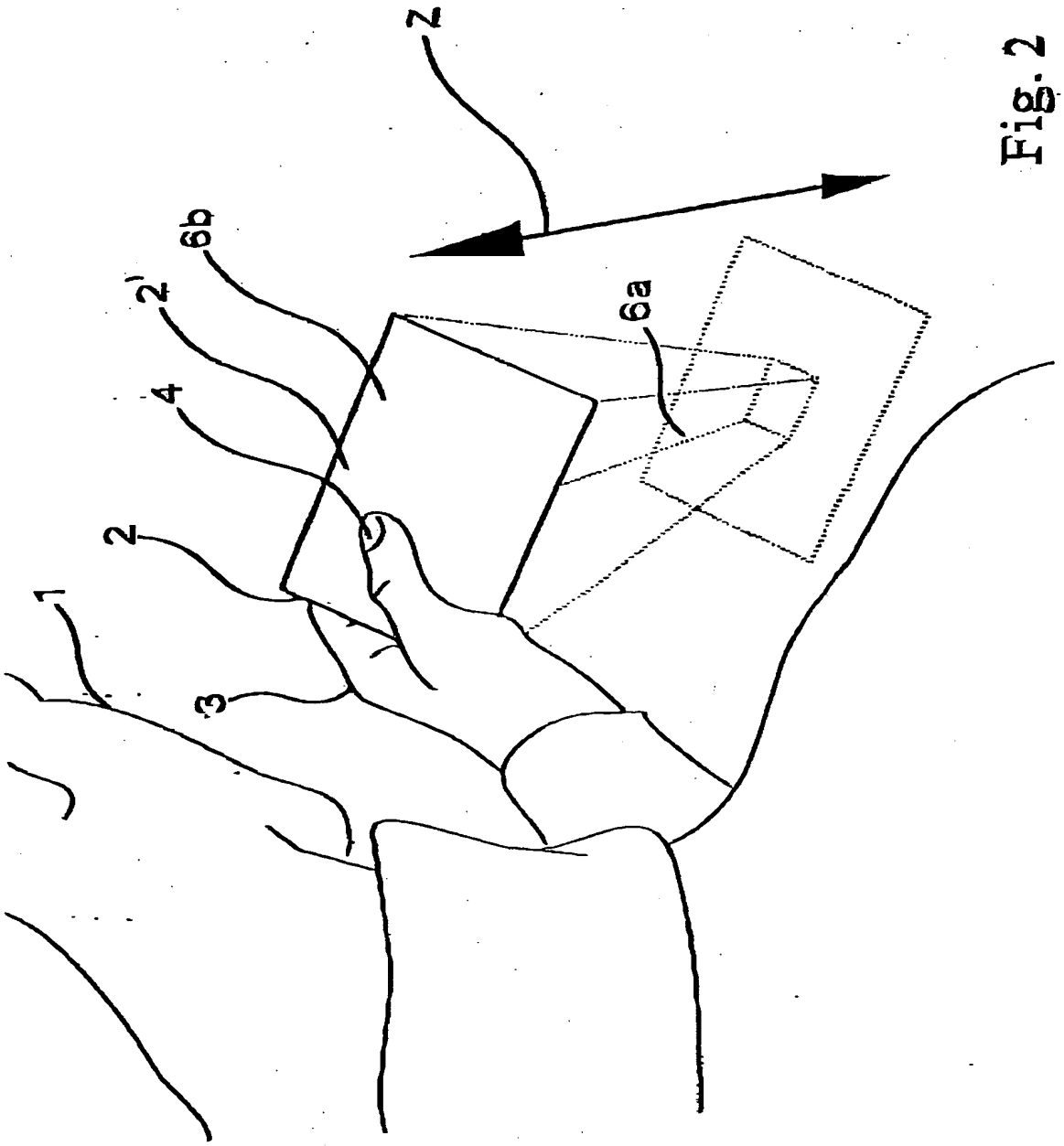

Fig. 2

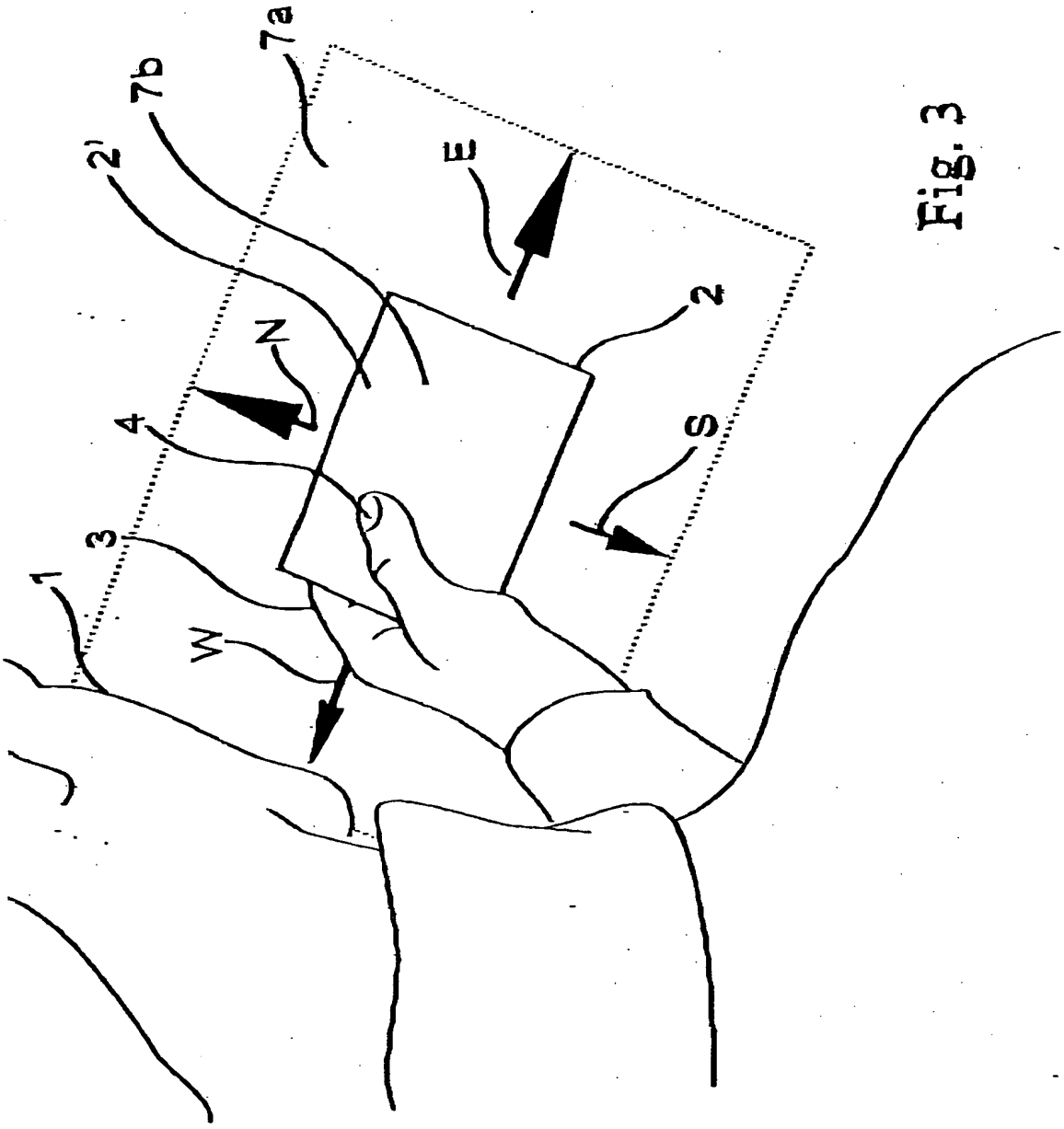

Fig. 3

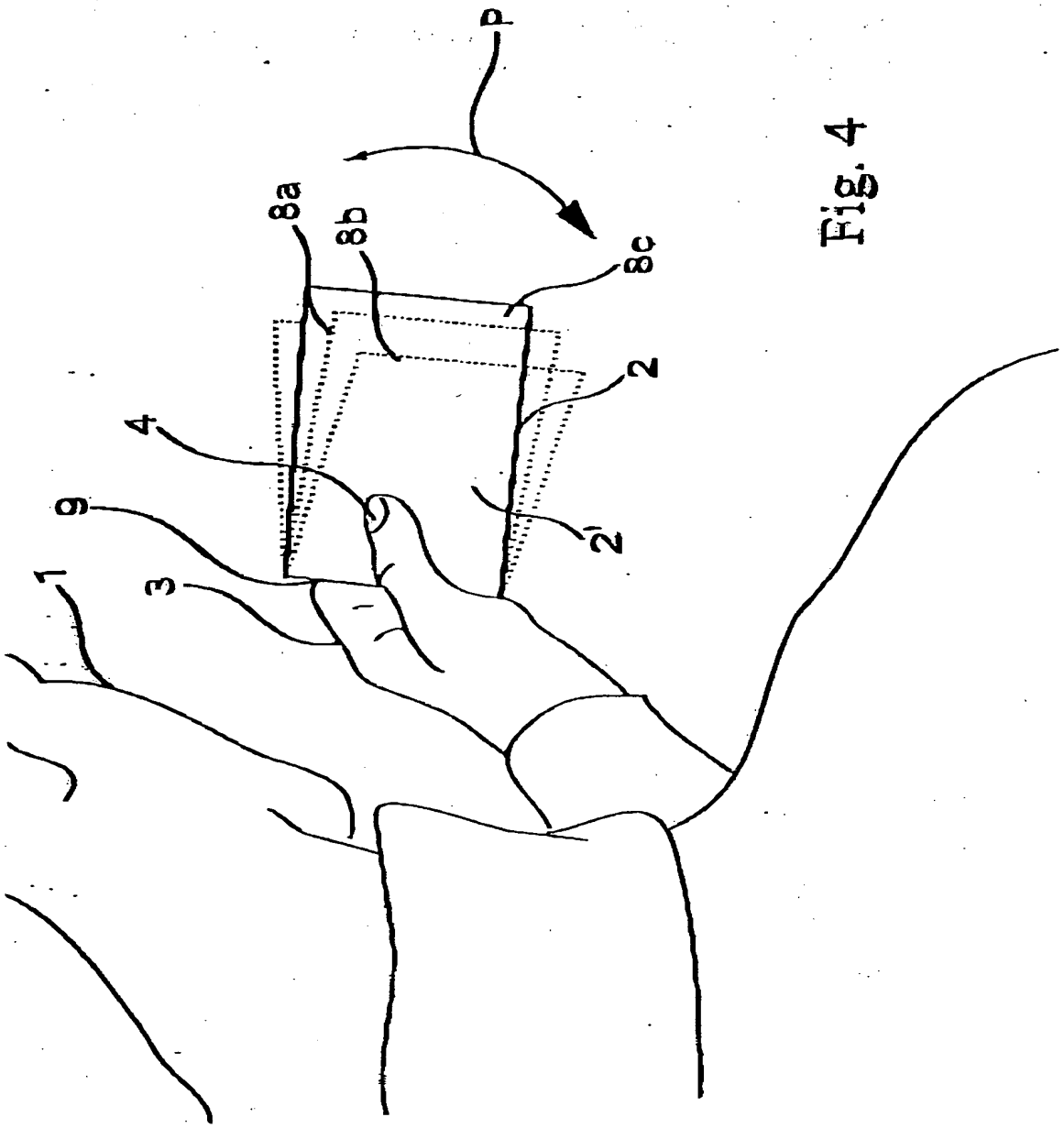

Fig. 4

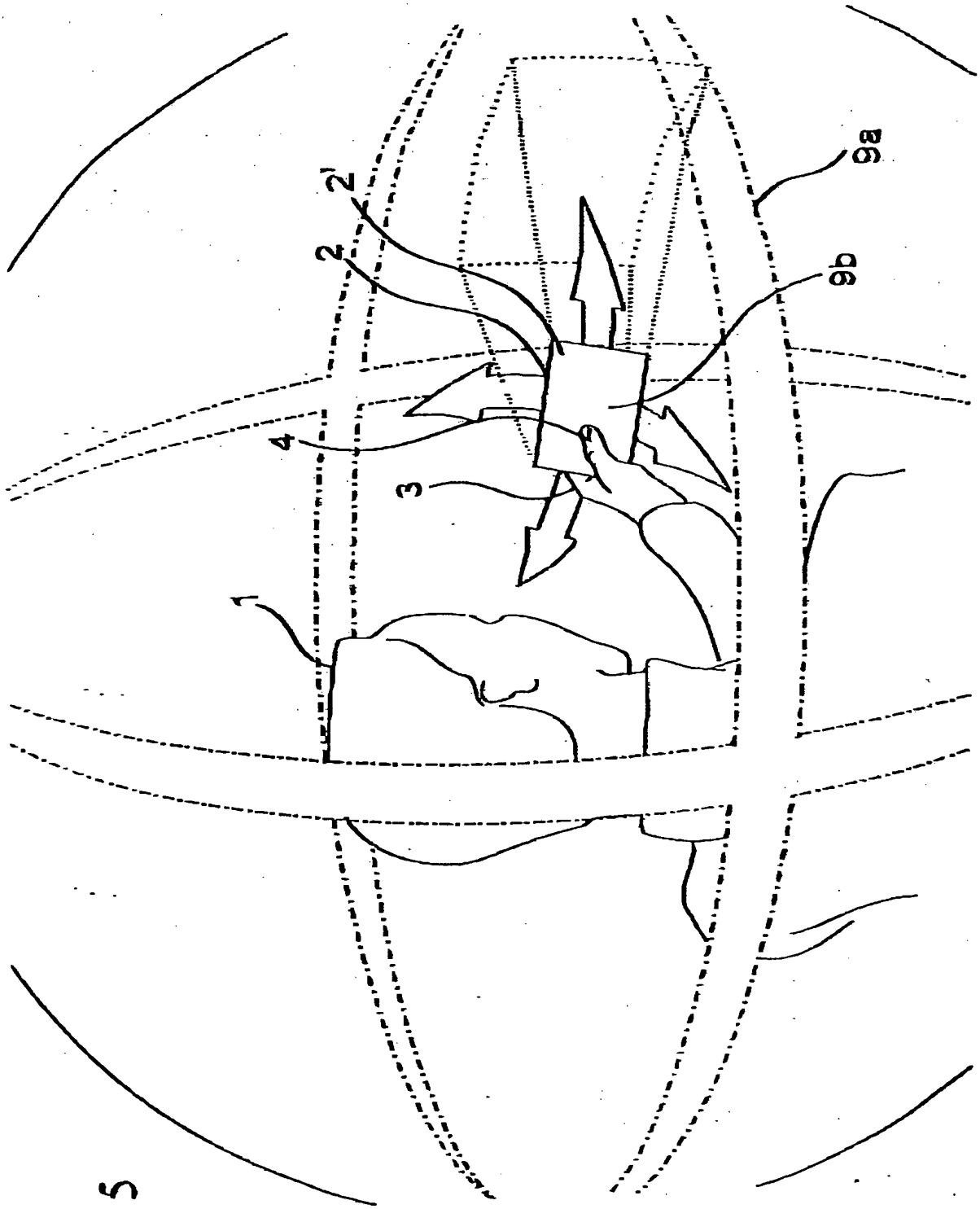

Fig. 5

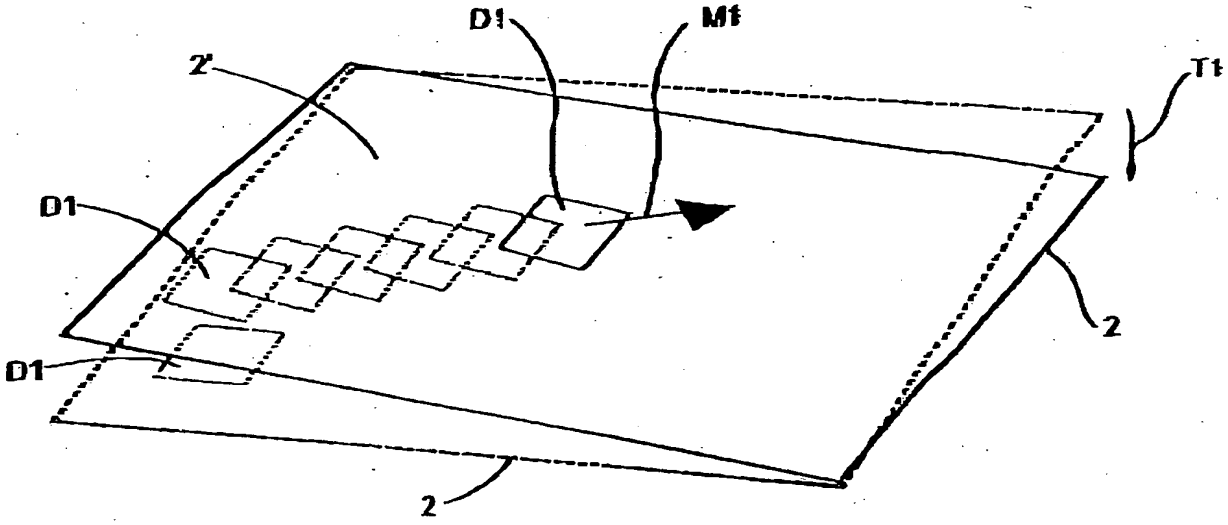

Fig. 6

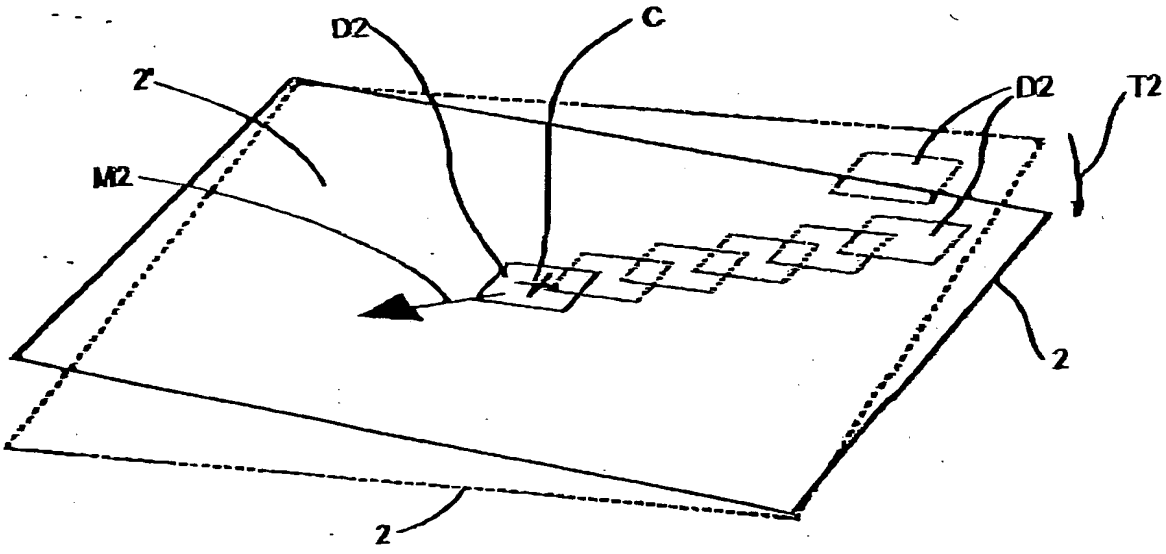

Fig. 7

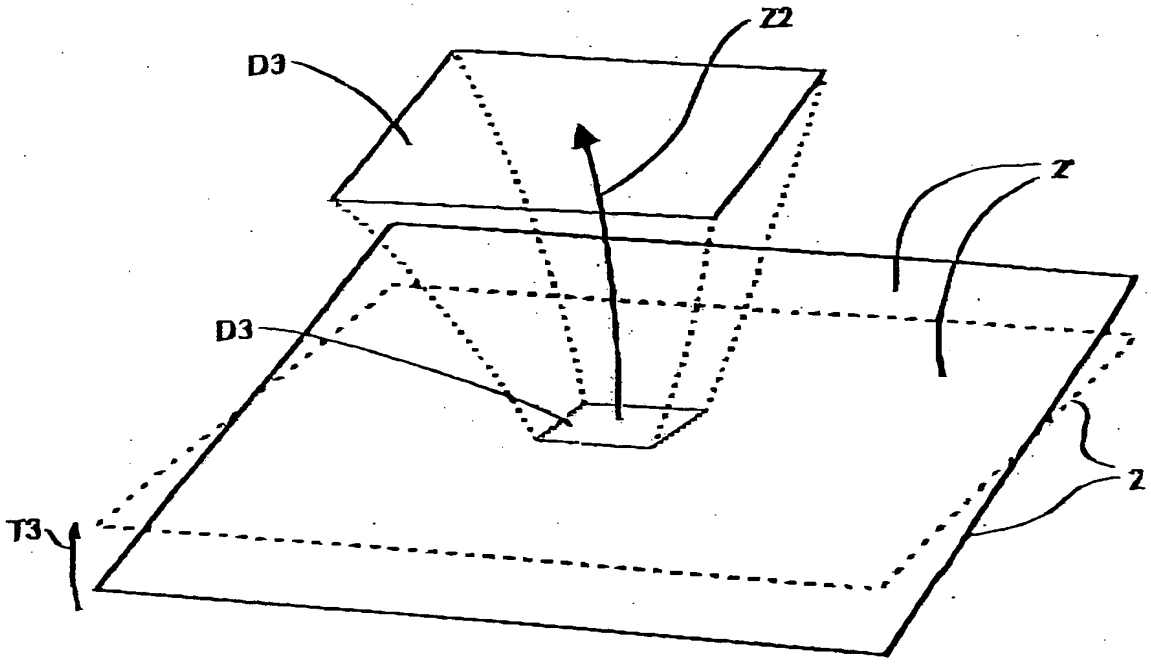

Fig. 8

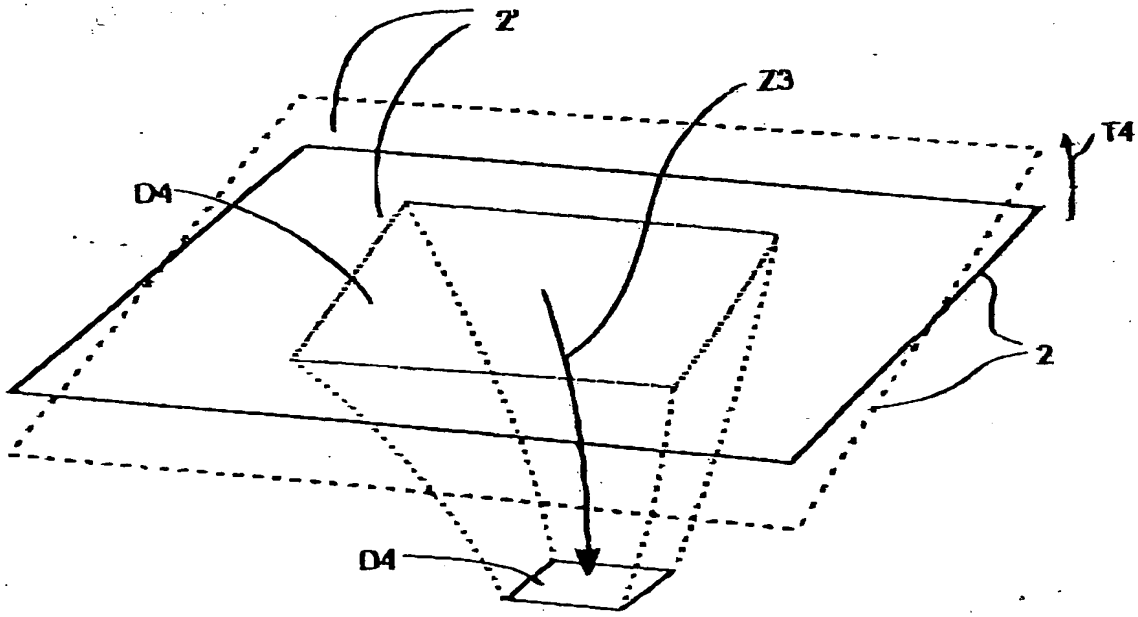

Fig. 9

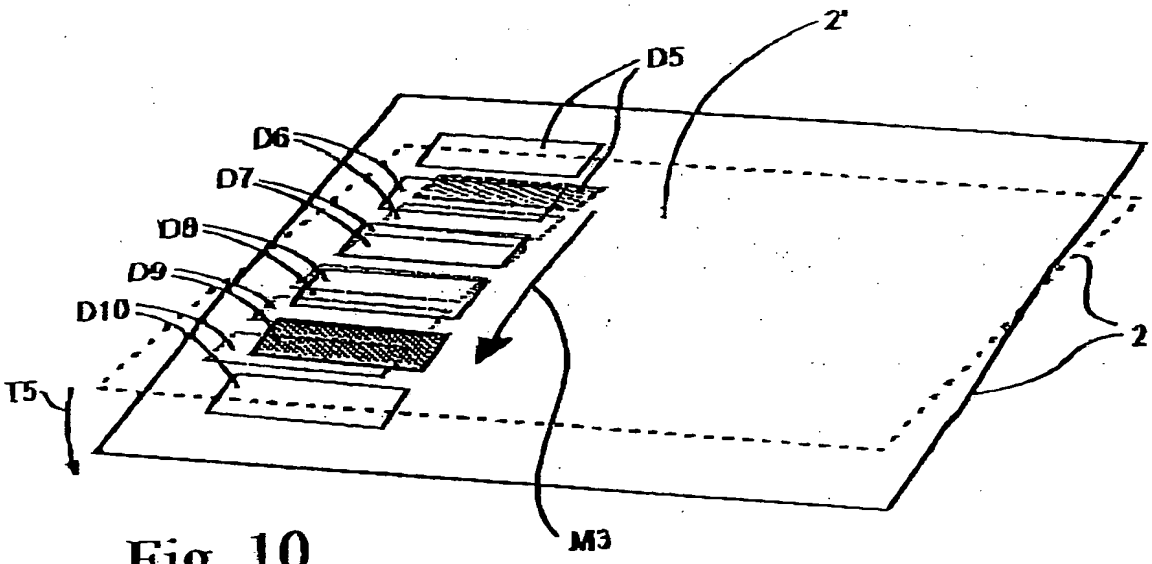
2'
D5
D6
D7
D8
D9
D10
T5
2
M3

Fig. 10

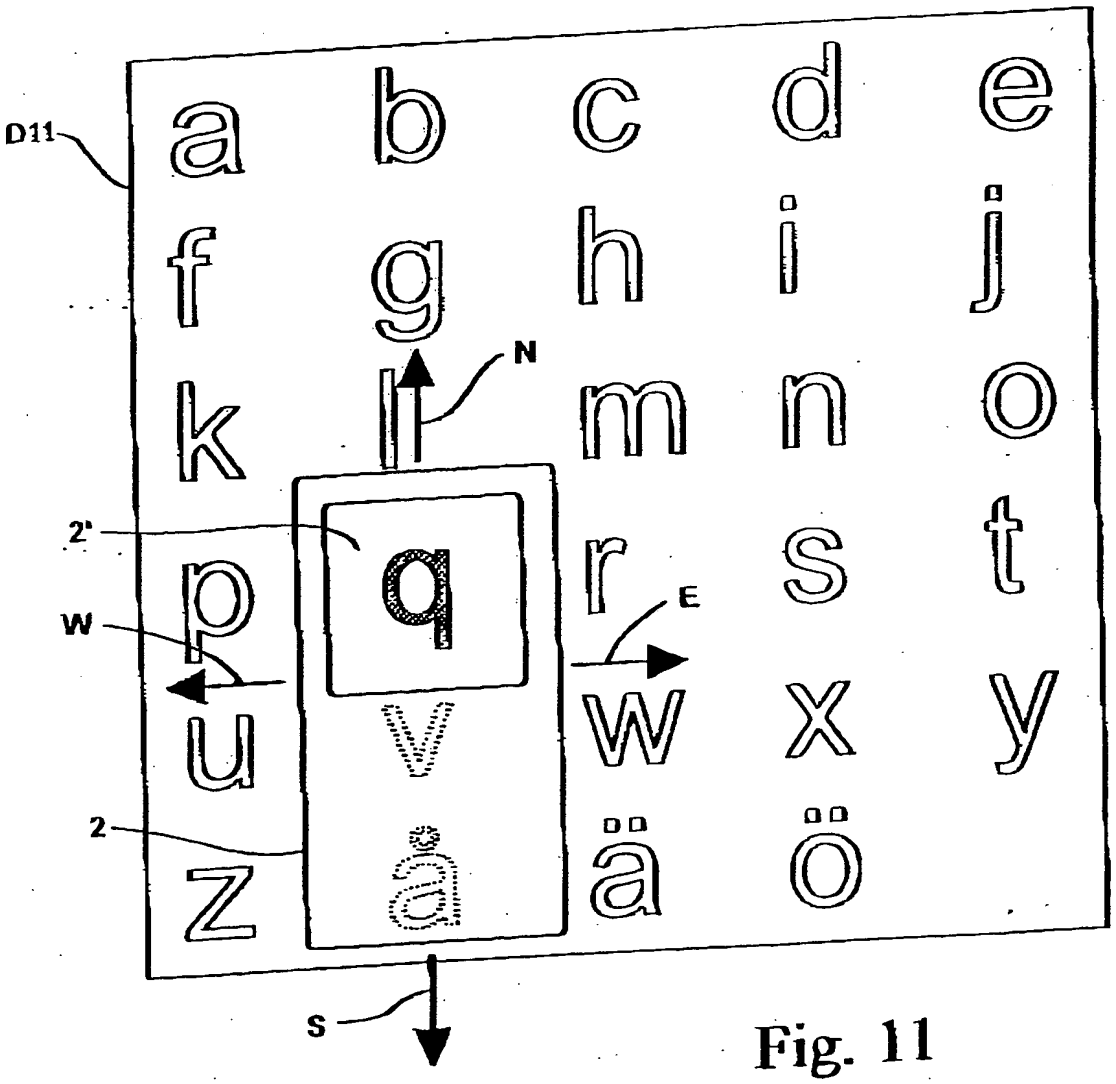
D11
a b c d e
f g h i j
k l m n o
p q r s t
u v w x y
z ä ö
N
2'
W
E
2
S

Fig. 11

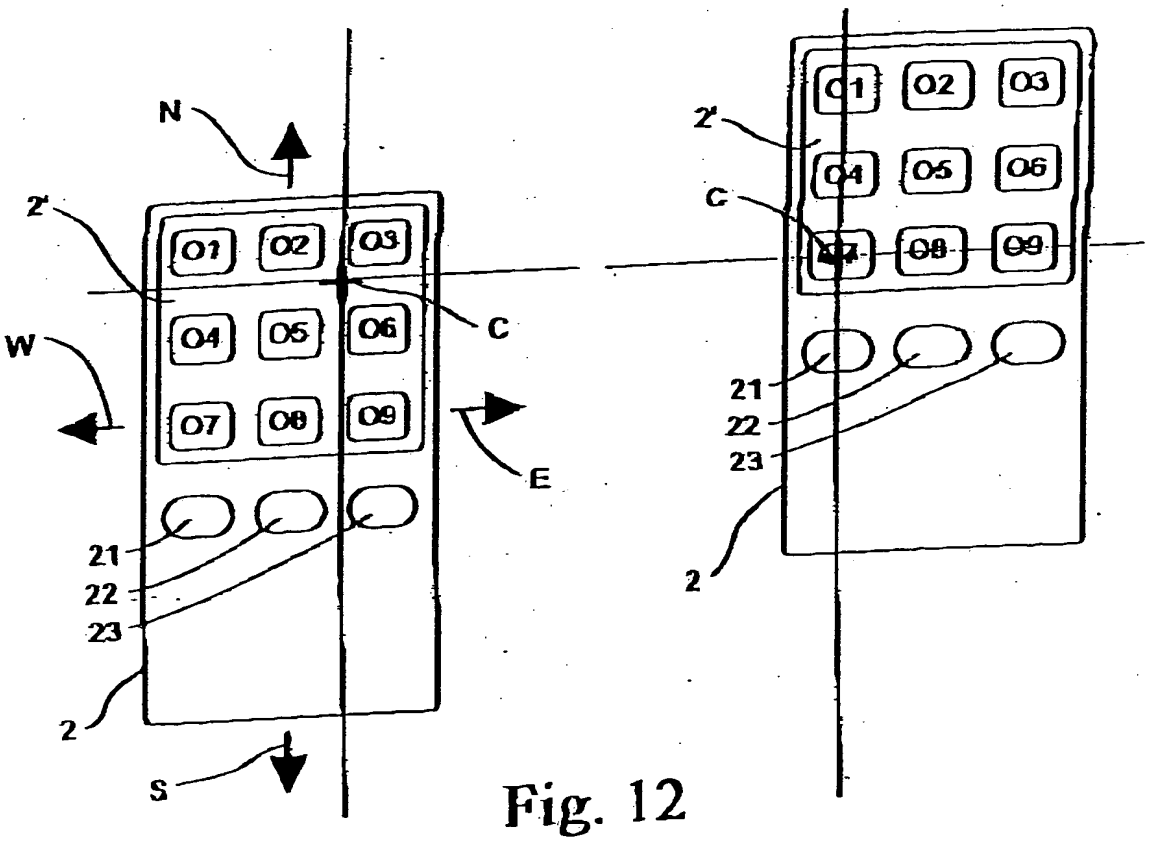
N
2'
O1
O2
O3
O4
O5
O6
O7
O8
O9
C
W
E
21
22
23
2
S

Fig. 12

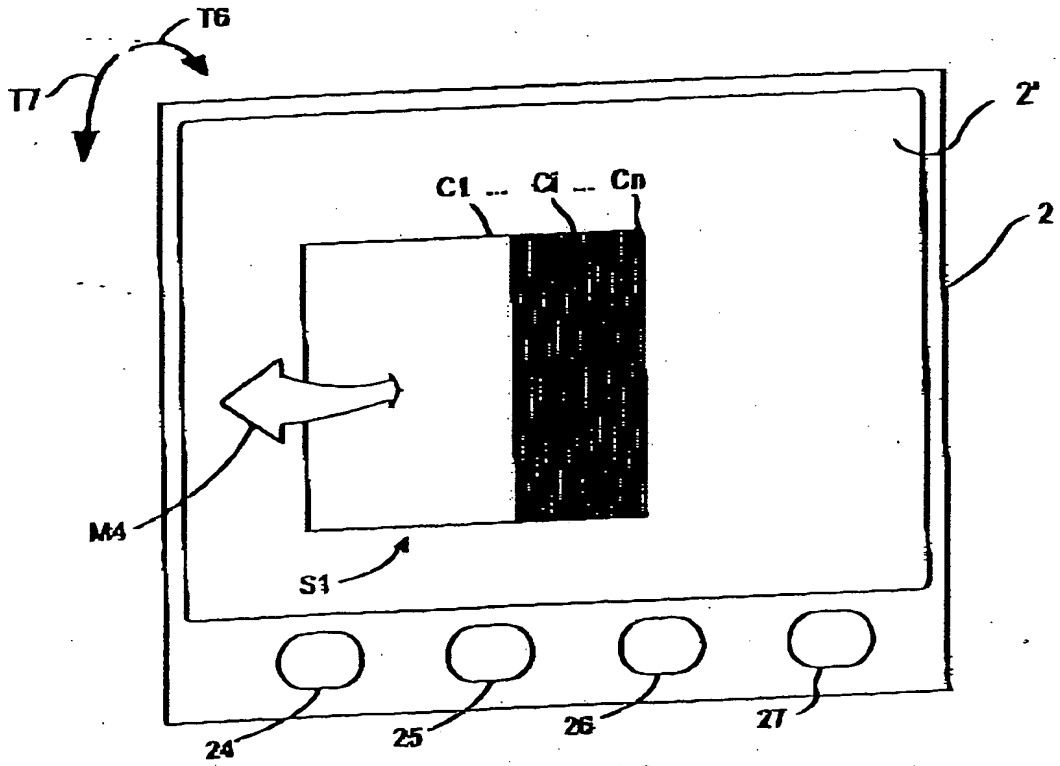
T6
T7
2'
2
C1 ... Ci ... Cn
M4
S1
24
25
26
27

Fig. 13

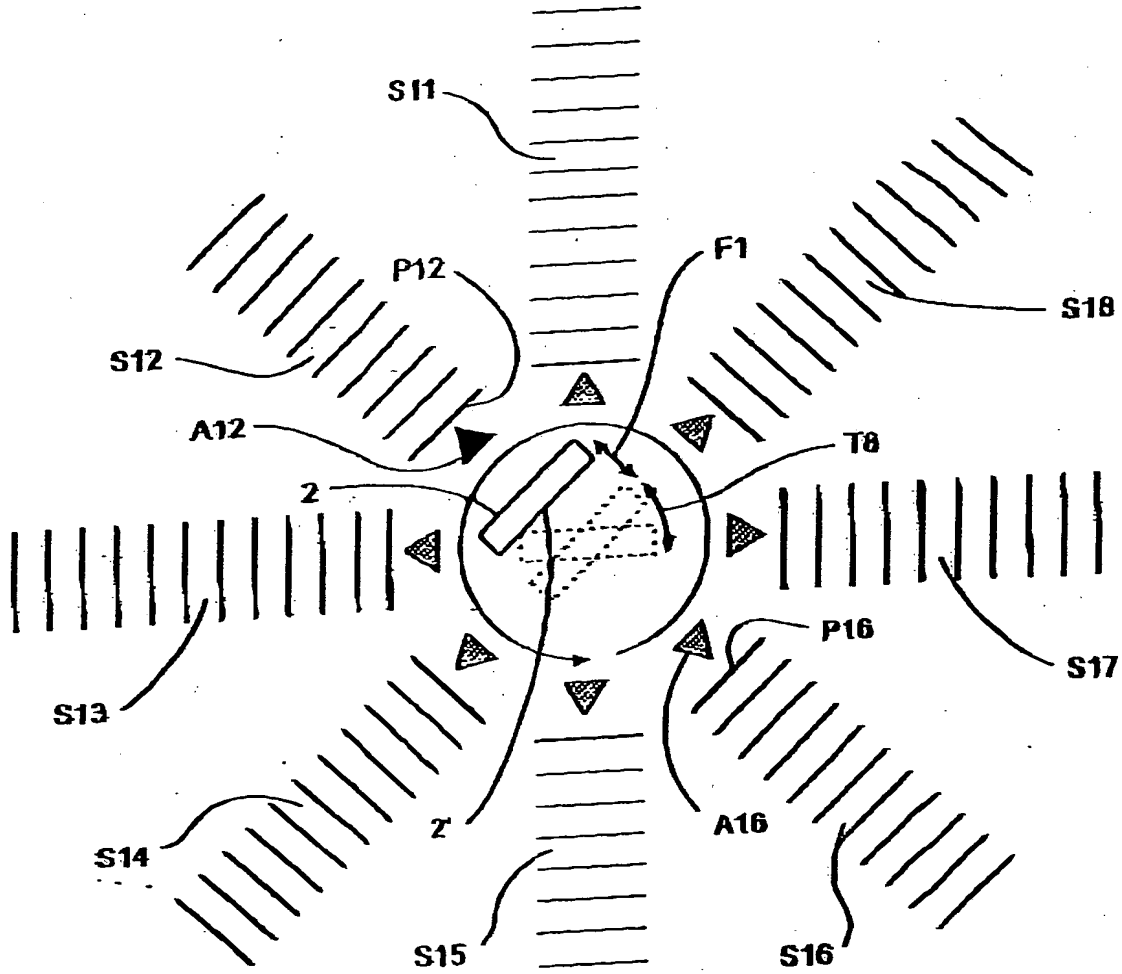

Fig. 14

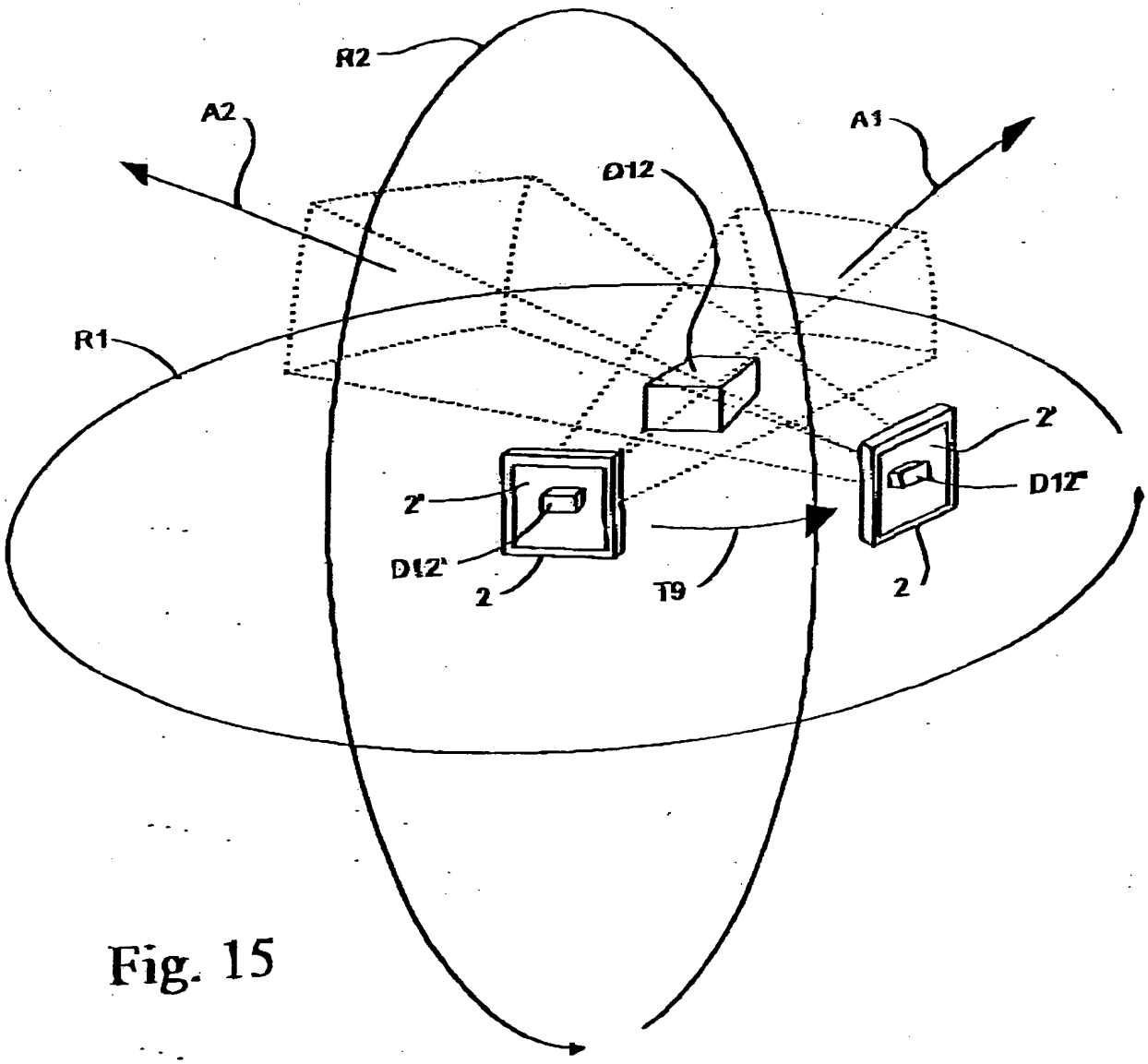

Fig. 15

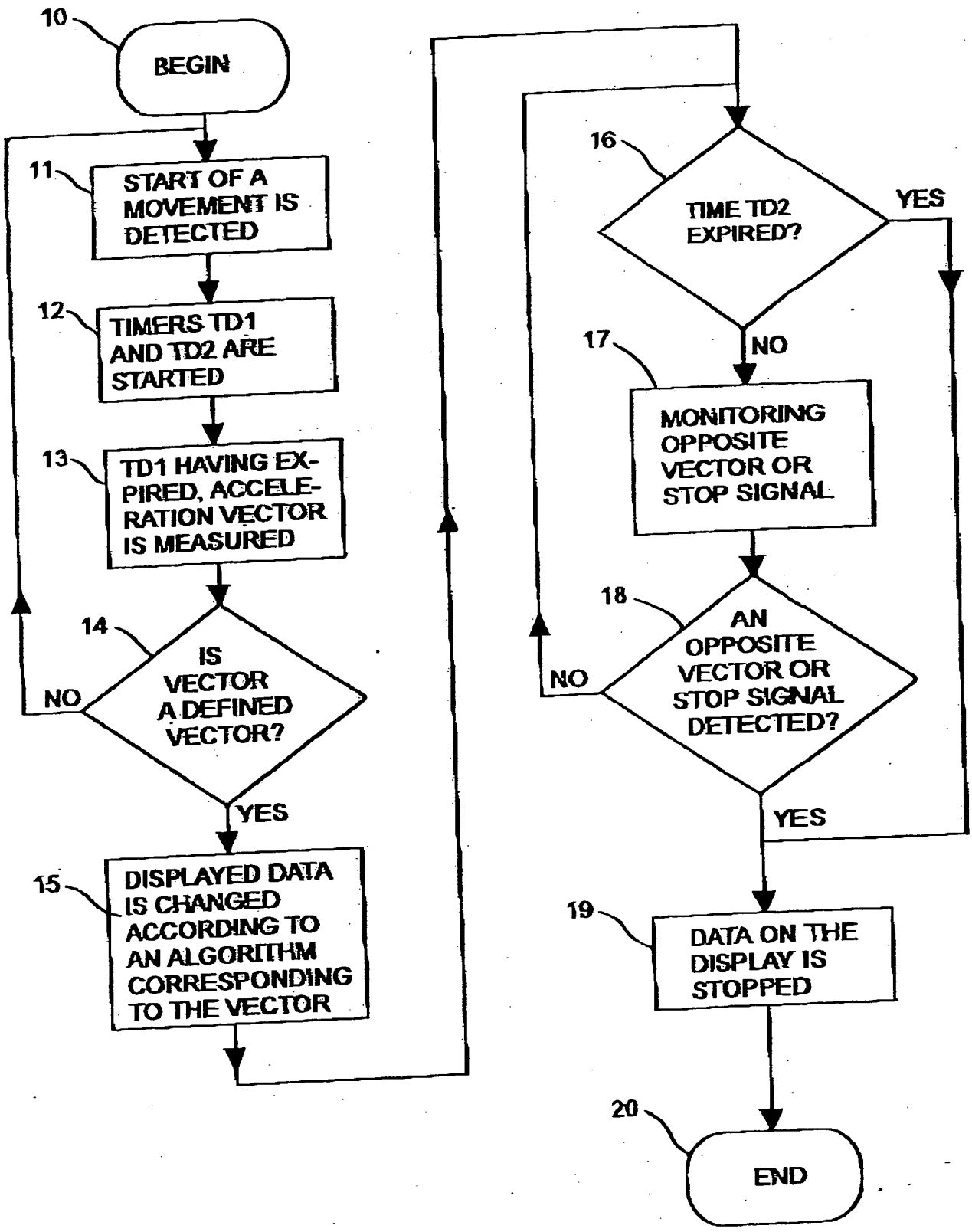
10
BEGIN
11
START OF A MOVEMENT IS DETECTED
12
TIMERS TD1 AND TD2 ARE STARTED
13
TD1 HAVING EXPIRED, ACCELERATION VECTOR IS MEASURED
14
IS VECTOR A DEFINED VECTOR?
NO
YES
15
DISPLAYED DATA IS CHANGED ACCORDING TO AN ALGORITHM CORRESPONDING TO THE VECTOR
16
TIME TD2 EXPIRED?
YES
NO
17
MONITORING OPPOSITE VECTOR OR STOP SIGNAL
18
AN OPPOSITE VECTOR OR STOP SIGNAL DETECTED?
NO
YES
19
DATA ON THE DISPLAY IS STOPPED
20
END

Fig. 16